

low temperatures and snow along their routes. On the 20th forecasts of high winds were sent to Nevada and Utah. On November 21 the morning forecast for southern California was "heavy rain this afternoon, to-night, and Thursday, with snow in the mountains and dangerously high southerly winds." High winds were also forecast for other parts of the district. Shipping and railroad interests were advised of heavy rains and high southerly winds. The forecasts were fully justified. The clearing weather which followed the storm was also accurately forecast.—*A. G. McAdie, Forecast Official.*

PORTLAND, OREG., FORECAST DISTRICT.

Following the storm of the 1st an unusually long period of fine weather prevailed, which terminated in a severe cold spell, attended by snow and blustering northeast winds that overspread the North Pacific States the night of the 17th and continued until the 22d. Freezing temperatures were experienced to the coast line for three days, and east of the Cascade Mountains zero temperature was reported at Spokane and Walla Walla. Both the cold weather and snow were accurately forecast, as was also the break to warmer, which occurred several days later. The warnings of cold were the means of saving several big shipments of potatoes that otherwise would have been frozen. Marine interests were kept fully advised of the approach of gales and high winds.—*E. A. Beals, Forecast Official.*

AREAS OF HIGH AND LOW PRESSURE.

During the month there were charted eleven highs and sixteen lows. A brief description of their movements and more prominent characteristics is given herewith.

Highs.—For the first time since May, 1900, with the exception of a portion of July, the highs exhibited a southeastward tendency, and the paths of a majority of them at times reached below the fortieth parallel. Nos. I, III, VII, and XI originated in the extreme central west, but pursued widely different paths. No. I moved from the Indian Territory northeastward to Ontario, and thence along a somewhat devious path to the Atlantic Ocean by way of Cape Breton Island. No. III originated in southeastern Wyoming and moved almost due southward through central Texas into the Gulf of Mexico. No. VII moved from the Kansas River Valley to West Virginia in twenty-four hours, and there disappeared, while No. XI maintained a fairly direct eastward movement from southeastern Wyoming to the Virginia coast. No. II first appeared on the Washington coast, moved eastward to North Dakota, and thence south-southeastward through Missouri and Mississippi into the Gulf of Mexico. No. IV moved from Columbia, N. W. T., to the Saskatchewan Valley, thence southeastward to the lower Ohio Valley, and thence eastward off the southern New Jersey coast. No. V followed much the same path as No. IV. Nos. VI and VIII moved across the extreme north from Alberta to the Atlantic Ocean. No. X was first noticed over northern Lake Superior, and from that section eastward followed very nearly in the paths of Nos. VI and VIII.

The characteristic winter type of high prevailed over the Plateau region except from the 14th to the 22d, inclusive, continuing at the close of the month.

Lows.—The lows were numerous and fairly regular in movement. Nos. I, V, XIV, XV, and XVI, moved eastward over the extreme north, No. I coming in over the Oregon coast. No. XVI dissipated in western Ontario, while the remaining three passed out the St. Lawrence Valley. During its progress No. V dipped down into the southern portion of the upper Lake region, afterward resuming its easterly course. Nos. XI, XII, and XIII, originated in the central Rocky Mountain

region, Nos. XI and XII passing into the Atlantic by way of the St. Lawrence Valley and Nova Scotia. No. XIII first traveled southeastward through the Southern States, turning northeastward after reaching central Alabama. It passed into the ocean off the southern New Jersey coast, and was afterward noted at Halifax, N. S., Sydney, C. B. I., and St. Johns, N. F. No. X originated in southwestern Montana, and moved down the eastern slope of the Rocky Mountains to central Texas, where it disappeared. Nos. IV and IX originated in the middle Mississippi Valley, the former moving to eastern Lake Erie, and thence south-southeastward to the Virginia coast, and the latter to the Atlantic Ocean just north of latitude 45°. No. VI was a local disturbance of great intensity that moved from southeastern New York through New England to the country north of the Gulf of St. Lawrence. Nos. II and VIII originated in the south Atlantic States, and both were last noticed in the vicinity of Bermuda.

From the morning of the 15th to the evening of the 19th a low of decided character was persistent near the Oregon, Washington, and British Columbia coasts, the barometer readings ranging in the neighborhood of 29.50 inches, and the depression extending into the north and middle Plateau region. It began to move southward during the night of the 19th, disappearing off the California coast during the night of the 20th.—*H. C. Frankenfield, Forecast Official.*

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
High areas.										
I.....	1, a. m.	34	96	4, a. m.	46	60	2,500	3.0	833	34.7
II.....	6, a. m.	47	123	10, p. m.	30	88	2,440	4.5	542	32.6
III.....	8, p. m.	48	122	12, p. m.	28	98	2,745	4.0	688	28.6
IV.....	12, a. m.	51	120	15, a. m.	40	75	2,725	3.0	908	37.8
V.....	14, a. m.	53	109	17, p. m.	41	70	2,400	3.5	686	26.6
VI.....	16, p. m.	54	114	20, a. m.	48	54	2,750	3.0	917	38.2
VII.....	21, a. m.	39	95	22, a. m.	38	80	800	1.0	800	33.3
VIII.....	22, p. m.	50	108	25, p. m.	46	60	2,365	3.0	755	31.5
IX.....	33, p. m.	50	110	29, a. m.	36	84	2,775	4.5	617	25.7
X.....	26, p. m.	48	85	29, p. m.	46	60	1,345	3.0	448	18.7
XI.....	28, p. m.	42	105	1, a. m.*	37	76	1,715	2.5	686	28.6
Sums.....							24,460	35.0	7,878	328.8
Mean of 11 paths.....							2,224		716	29.8
Mean of 35 days.....									699	29.1
Low areas.										
I.....	1, p. m.	45	117	4, p. m.	48	68	2,825	3.0	942	39.2
II.....	3, a. m.	34	82	5, p. m.	32	65	1,075	2.5	430	17.9
III.....	5, a. m.	45	73	6, a. m.	46	60	700	1.0	700	29.2
IV.....	6, a. m.	41	96	8, a. m.	37	76	1,400	2.0	700	29.2
V.....	7, p. m.	54	114	12, a. m.	48	68	2,490	4.5	553	23.0
VI.....	8, a. m.	41	74	10, a. m.	48	68	650	2.0	325	13.5
VII.....	11, p. m.	48	85	13, a. m.	48	68	900	1.0	900	37.5
VIII.....	11, p. m.	32	81	13, a. m.	32	65	1,000	1.5	667	27.8
IX.....	12, p. m.	43	91	14, p. m.	46	60	1,700	2.0	850	35.4
X.....	13, p. m.	47	112	15, a. m.	31	101	1,325	1.5	883	36.8
XI.....	17, a. m.	41	107	21, p. m.	48	68	2,425	4.5	539	22.5
XII.....	21, p. m.	40	105	24, a. m.	48	54	2,675	2.5	1,070	44.6
XIII.....	21, p. m.	41	111	25, a. m.	48	54	3,840	6.5	591	24.6
XIV.....	25, a. m.	53	121	29, a. m.	45	80	2,325	3.5	664	27.7
XV.....	27, p. m.	54	114	1, a. m.*	46	78	1,800	4.0	514	16.7
XVI.....	30, a. m.	54	114	2, p. m.*	47	85	1,550	2.5	620	25.6
Sums.....							30,280	48.0	11,348	472.8
Mean of 17 paths.....							1,781		667	27.8
Mean of 48 days.....									631	26.3

*December.

RIVERS AND FLOODS.

The Mississippi River from its source to the mouth of the Illinois River was somewhat lower than during October, 1900; from the mouth of the Illinois to the mouth of the Ohio there was but little change, while below the mouth of the Ohio stages

were from 2 to 3 feet higher, the water coming from the Ohio River on the earliest, and again on the latest days of the month. As compared with the corresponding month of 1899, the average stage for the entire river shows an increase of about 4 feet, which must be attributed mainly to the mildness of the temperature over the northern portion and the heavy rains over the Ohio watershed. The water from the Chicago Drainage Canal through the Illinois River also contributed, to a certain extent, toward the increase of the water level. The precise effect which this canal is exercising upon the stages of the Mississippi River can not be determined with any degree of exactness until a series of observations from low water to flood stages has been obtained.

The Ohio River stages were much higher than in October, on account of the moderate flood of the latter part of that month, the crest of which did not pass Cairo, Ill., until November 3, and of another, of more decided proportions, during the latter days of November. This latter flood was caused by heavy rains over the Ohio watershed from the 24th to the 26th. Danger-line stages were reached above Wheeling, W. Va., except along the Allegheny River, where they were not quite so high. The proportionately lower stages below Wheeling may be attributed to the fact that the heavy rains came first from the southwest, causing a sharper flood plane, and a consequent increase in the velocity of the stream-flow over the lower river. By the time the rain had reached the upper basin the water below had largely run out. The same amount of water from a general rain, well distributed over the entire watershed, would have caused a decided flood along the whole length of the river. The following account of the flood in the upper Ohio is taken from the report of Mr. Frank Ridgway, official in charge of the Weather Bureau office at Pittsburg, Pa.:

The heavy rains of November 20 and 21 terminated a long period of drought over the Allegheny and Monongahela valleys. From 1 to more than 2 inches of rain fell on those dates, but they did no more than to saturate the dry soil and start the springs. The heavier rains that began four days later fell upon soil already saturated with moisture, and consequently nearly all of this water quickly found its way into the rivers. On the morning of the 26th the reports from the upper rivers showed that the heavy rains had filled all the streams and that they were rising rapidly. Hourly observations were ordered from noon to 6 p. m. When the 2 p. m. reports were received, showing that the upper rivers were rising from 1 to 2 feet an hour, warnings were immediately issued, through the departments of justice of Allegheny and Pittsburg, the press, and by telegraph and telephone, in all directions along the three rivers, to prepare for 25 feet or more of water by midnight. The river at this point (Pittsburg) passed the danger line of 22 feet about 9 p. m. and was rising about 1 foot an hour. Later reports from the upper rivers justified this office in sending out a second warning at midnight that a stage of at least 28 feet would be reached by noon of the 27th, and that all movable property liable to damage by water at a 28-foot stage should be removed to places of safety.

This flood was unprecedented at Pittsburg for the time of the year, with the possible exception of the "pumpkin flood" of November, 1810.

General attention was given the warnings, and it is estimated that over \$1,000,000 worth of property was saved by removal to places of safety before the crest of the flood waters reached the city, which was twenty hours after the first warning was issued. The highest stages reached at the city were 27.7 feet on the Monongahela River, 28.2 feet on the Allegheny River, and 25.6 feet on the Ohio River, and all occurred between 9:30 and 11 a. m. An unusual deficiency of rainfall had necessitated the suspension of navigation throughout the entire summer and autumn. It can therefore be readily seen what this rise meant to the river interests of Pittsburg. During the last week of November nearly 150,000,000 bushels of coal were shipped by boat to southern markets, and at the same time the construction work of the season came to an end.

The flood in the lower Ohio was more moderate, and the

following report thereon was made by Mr. P. H. Smyth, official in charge of the Weather Bureau office at Cairo, Ill.:

A general rise in the Ohio River was in progress on November 20, 1900, due to general rain over the entire watershed. For five days subsequent to the initial rise, heavy rain continued quite general over the watersheds, which kept the lower river rising until December 3-4, 1900. The rise in the lower Ohio was augmented also by rises out of the Cumberland and Tennessee rivers.

The maximum stage reached at Evansville was 33.6 feet on December 3, and the maximum at Cairo was 32.6 feet on December 4. The maximum stage predicted for Evansville was between 34 and 35 feet, and for Cairo between 32.5 and 33 feet.

So far as learned no material damage resulted from the high stage. Warnings were sent out well in advance of the flood, and what property was in danger was removed to places of safety, as far as practicable.

Mr. Charles M. Spencer, Mount Vernon, Ind., in reporting on the high stage at that point, writes as follows:

"Information was posted on bulletin board, published in daily papers, and sent to neighboring post offices. No property was in danger, except logs and small amount of corn standing in fields. The logs were rafted and taken to mill, and the corn was cribbed. The approximate value of property protected was \$25,000, all of which was practically saved."

Mr. Charles Carroll, Shawneetown, Ill., reports on the high stage as follows:

"Information sent to farmers in river bottoms, Saline River to New Haven, Ill., and sent to those on Kentucky side; also sent by mail to all offices in this vicinity where people are interested. Immediate action was taken to drive stock out of the bottoms, crops and other property protected or removed. Approximate value of property (crops and stock) protected, probably \$600,000. Only a small amount, comparatively, of this was lost—some corn ungathered. Farmers having corn not gathered, at the news of the flood, called in assistance, trebled their forces, and saved by far the most of their crop. Such information is invaluable."

The rivers of the Atlantic system also rose considerably during the latter days of the month, owing to heavy rains from the same storm that caused the flood in the Ohio. The Susquehanna River at Wilkesbarre, Pa., reached a stage of about 25 feet, or 11 feet above the danger line, during the night of the 27th. Previous unpleasant flood experiences were wanting, however, as the two new bridges across the flats prevented the suburbs in that section from becoming isolated. The rise was not so marked in the lower river and in the West Branch.

The James River rose 10 to 15 feet from the 25th to the 27th. A stage close to the danger line was reached at Richmond, Va., warning of which was issued on the 27th. Along the water front property liable to damage was removed to places of security, and no avoidable losses occurred.

Nothing of interest occurred along the rivers of Texas and the Pacific coast.

Floating ice was observed during the month in the Mississippi River as far south as Prairie du Chien, Wis., and in the Missouri as far as Omaha, Neb. The latter river closed entirely at Bismarck, N. Dak., on the 16th, and as far south as Sioux City, Iowa, on the 20th.

Navigation on the upper Mississippi was officially closed on the 20th.

The highest and lowest water, mean stage, and monthly range at 127 river stations are given in Table XI. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are: Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—H. C. Frankenfield, *Forecast Official*.